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ABSTRACT

The two major models of science curriculum change, textbook revision and national curriculum projects, are derived from, and reinforce, the present curriculum structure. This is undesirable in a time of increasing fluidity and change, because adaptation to new situations is difficult. Unified science, based on the premise that science is a unity, offers a more flexible approach. Reasons supporting the view that science is a unity range from the philosophical point that there is only one universe to the pragmatic one of educational advantages with respect to universal scientific literacy. An ideal science curriculum would span the total period of general education from kindergarten to grade 12 or 14, and would be built of modules of varying length. A relatively small number of major concepts and a "spiral approach" would provide continuity. Testing within the ideal program would emphasize higher level cognitive skills and the social implications of science. Unified science curricula can be implemented by obtaining a consensus among teachers in a school district of the articulating concepts to be used, cooperative selection or development of modules, and the replacement of the existing programs one year at a time until all grade levels are using the unified program. (AL)

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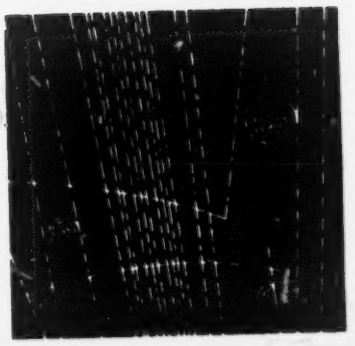

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by
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TOWARD A UNIFIED SCIENCE CURRICULUM

Science Curriculum and the Future

Questions about what science should be taught and how it should be taught are going to persist even after a thousand curriculum development projects have been completed. Therefore, it is imperative that science educators and teachers accept and adopt the view that curricular charge in science will be, and should be, a continuous process.

Science topics which are relevant and interest provoking today, as is "Pollution," may well give way to other topics tomorrow. Remember how the topic of "Atomic Energy" waxed and waned during the past decade as an interest grabber. Some may disdainfully refer to this changeability in public interest as a "fashion of the times." However, the change does occur and all educators must acknowledge and utilize all psychologically rooted "handles" if the goal of universal scientific literacy is ever to be achieved.

The nature of science itself is undoubtedly less changeable. But the content of science is subject to change as concepts are developed, principles are established, and the techniques of science are applied to different natural phenomena.

It has been estimated that the body of knowledge resulting from science is growing at an increasing rate. Thus, the person who seeks to be broadly educated in science has, on the surface at least, an increasing amount in which to be educated. Knowledge about how people learn and newly available hardware resulting from technological advances both contribute to making the science teaching situation richer and more affective, and even more fluid. The immediate prospect for the future in science education then is one of increasing fluidity and change. It is in this certain, yet uncertain, frame of reference that a question crucial to science education must be asked: "What curriculum structure in science will be most appropriate for the future?"

Two Change Models from Past

There are two principal exemplars from the past which offer possible models for enabling science curriculum change in the future. (1) textbook revision and (2) national curriculum project. Each of these models has serious shortcomings only a few of which will be mentioned here.

The textbook revision model is essentially a process of accumulation. Chapters are added to a book originally designed to be the core of a given science course. It is nearly impossible to ever drop a chapter in a new edition because that

chapter will have become a favorite of some teachers and, consequently, sales will be lost. Every edition of a text means added chapters and greater length. After two editions, every science text becomes too long to be covered in a year's work. Yet, many teachers feel a compulsion to cover the entire text and, as a net result, the quality of teaching and learning declines. The inadequacy of the textbook revision model is further emphasized by serious questions regarding the psychological desirability of having a single text in the first place. After all, if a goal of education is to produce individuals capable of and predisposed to continuing study outside of school, why base all learning on textbooks which are essentially not available outside of a school setting?

The national curriculum project provides a second model for facilitating future change in the science curriculum. It has some undeniable strengths in that vast human resources can be devoted to the task of synthesizing a year's course of study. However, the typical product is a textbook the same as in the textbook revision model. (A few notable exceptions exist.) The new textbook, arising from the national curriculum project, is more than a collection of obsolete chapters, topics, and concepts. It is fresh. Its content reflects the point of view of the contemporary chemist,

or physicist, or physiologist, or geneticist, etc. Its pedagogy may even apply some recent understanding about how people learn. However, the national curriculum project textbook has shortcomings. Typically, it is too long; it is too abstract and too difficult for most learners; it seems to be designed with the science major in mind; it presents science as authoritarian; it fails to provoke or even maintain interest in science by the learner; it is organized around the perspective of the specialist rather than that of the humanist; it serves as the starting point for textbook revision processes which ultimately lead to another cataclysmic national curriculum project.

Both of these models for curriculum change are derived from the present curriculum structure, and, in turn, reinforce that structure. Thus, it appears that chemistry is bound to be an eleventh grade subject that lasts exactly two semesters. This limitation is not rational--at best it is institutional and it can only inhibit desirable changes.

Up to this point, I have attempted to develop a picture of a need for a fresh approach to science curriculum development. The remainder of this paper is devoted to describing the unified science approach which not only provides an alternative model but also has built-in factors which facilitate evolutionary change over an indefinite period of time,

and therefore can be labeled the "ultimate approach."

The Basis of Unified Science

It must be emphasized that there are, have been and will be various approaches to science curriculum development that are rightfully labeled unified science. Each has unique features of its own which may depart somewhat from the assertions and descriptions that follow.

A unified science approach to curriculum is based on the premise that science is a unity. It is a unity because science is more than a sum of its parts. That is, science as a natural phenomenon is more fully understood by studying the whole phenomenon of science rather than by studying fragments of it as represented by the separate sciences. Science is viewed as a unity that has been fragmented only as a convenience in defining narrow fields for specialized research.

This view of science as a unity is paralleled by the view that an organism is more than the sum of its parts. The approach is holistic rather than particulate. That is, one starts with the whole of science (or the whole organism). This does not mean that the parts are of no use in seeking an understanding of the whole--on the contrary the parts are very useful but they are subsidiary to the whole.

It should be noted that the view of science as a unity regards unity as the prior condition. The unified science view does not reflect a combining of entities that heretofore had been separate. In considering the question, "which came first, science or the sciences"? The unified science answer is clearly, "science."

Reasons Supporting the Unity of Science

There are many logical reasons that can be advanced to support the unity of science view and give the view a status that is more substantial than that of arbitrary assumption. Several of these reasons listed without regard to order of importance or overlap are:

1. There is only one universe. Things and events in the universe are not naturally separable from each other.
2. All science originates in a common source: man's intellectual activity. Science is man's effort to impose order on natural phenomena (note that the question of whether nature is orderly is meaningless).
3. There is a single set of values that underlie all the separate sciences and undoubtedly, gave rise to science in the first place. Among these are: ". . . Questioning of all things . . . Demand for verification . . . Search for data and their meaning . . ." (2)

4. All the sciences have a common ultimate goal--the development of one theory to explain all natural phenomena.
5. A single structure can be used to explain the internal structure of all science or each of the separate sciences. Several alternatives have been devised to show relationships among the elements of science (e.g., concepts, laws, principles, theories, etc.) and are broadly applicable (3,5).
6. A common set or case of concepts permeates all the sciences. Examples are: energy, equilibrium, model, and field (4, 5, 7).
7. The procedures used by the separate sciences in establishing new knowledge are very similar (8).
8. The technological problems to which science is properly addressed always require several separate sciences. Present problems of environment quality and space flight are examples.
9. The unity of science has unique educational values in the areas of universal scientific literacy, personal relevance of science, and background for potential scientists.

The reasons supporting a unity of science viewpoint have

been listed in an order which spans the spectrum from philosophical to pragmatic. In devising actual unified science courses various curriculum developers have cited different combinations of reasons as being the motivating force behind their efforts. However, the pragmatic reason is always one of those cited.

Characteristics of an Ideal Unified Science Curriculum

The ideal unified science curriculum would span grades K-12 or K-14 depending on the length of formal education devoted to general education. The curriculum itself would be a sequence of x modules units of study assembled by the local science teachers. Each module would contain subject matter from several traditional science disciplines and would include content from sciences such as experimental psychology, anthropology, meteorology, and nuclear science. The length of modules could vary from two to nine weeks.

Vertical continuity of the sequence would be developed around a relatively small number of major concepts, big ideas or cross-cutting ideas that permeate all sciences (5, 7). A model of learning that assumes conceptual development through ever increasing levels of sophistication (i.e. a spiral approach) would be used to guide statements of expected cognitive and affective outcomes of learning.

The modules themselves would be based on topics or themes that would appeal to the contemporary age groups for whom they are designed. Modules could be based on slotcars, bicycles, the moon, or school behavior. Some modules could capitalize on local phenomena such as the Indiana sand dunes, the Allegheny River, or the Oxford paper mills.

Within each module, there should be alternative pathways for individuals to achieve a minimum set of objectives. For instance, one pathway could be a series of illustrated group lectures, another a series of readings, and yet another a minor laboratory research problem. The learner himself would decide which pathway he would follow.

Within the modular structure lies the facility for continuous evolution of the unified science curriculum. A module may be replaced or revised without requiring the massive effort needed to revise a whole year's work.

Unified Science Testing Program

Test would reflect the basic philosophy of unified science and would be based on the assumption that not all individuals would, or should, learn the same things from a given module. Emphasis would be placed on achieving cognitive levels of three and higher in Bloom's Taxonomy (1). Tests that deal with the

social implications of science and other aspects different from conventional chemistry, physics, and biology content would be used.

Implementing a Unified Science Program

The first and most crucial step is obtaining a consensus among the teachers who will be working on it that a unified science approach is best. Doing this may require some compromise. For instance, maybe the senior high school (grades 9-12) or the middle school (grades 6-8) science teachers rather than all science teachers (k-12) form a more potentially receptive group in a given school system. Whatever the group it will serve as a nucleus for later expansion of the idea. The community served by the school should be part of the decision making (or convincing) process. So too, should other representatives of the school system.

The second step is for the science staff to get organized for curriculum development. This may well consist of two phases: (1) identifying the articulating concepts to be used and (2) selecting and arranging modules. The latter task is not so formidable as it may first appear. There are many potential sources of modules. Of course, given sufficient resources, a staff could build its own modules. The important thing is that

the staff be involved in building the curriculum.

The third step is scheduling the unified science program to replace whatever is extent. This is usually best done by replacing one year at a time. For instance, the first year unified science could be initiated in grade 9. The next year in grade 10 and so on.

Source of Guidance

Several sources of guidance and assistance for developing unified science programs are available from among the people who have been involved in such programs. Contact with them can be made through the Federation for Unified Science Education (FUSE), Box 5044, Cleveland, Ohio 44101.

References Cited

1. Bloom, B.S. (editor). Taxonomy of Educational Objectives, Longmans-Green, New York, 1956.
2. Educational Policies Commission. Education and the Spirit of Science. National Education Association, Washington, 1966.
3. Margenau, Henry. The Nature of Physical Reality. McGraw-Hill, New York, 1950.
4. National Science Teachers Association. Theory into Action. The Association, Washington, 1964.
5. Showalter, Victor. "New Directions for Science Curriculum Development," ERC Papers in Science Education, Number 2, Educational Research Council of America, Cleveland, 1968.
6. Showalter, Victor. "A Model for the Structure of Science," ERC Papers in Science Education, Number 10, Educational Research Council of America, Cleveland, 1969.
7. Van Deventer, W. C. "An Inquiry Approach to Interdisciplinary Seventh Grade Science." Journal of Research in Science Teaching, Vol. 5, 1968.

8. Ziman, John. Public Knowledge. Cambridge University Press, Cambridge, 1968.

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